Issue #2

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INSTRUCTION MANUAL for

KROHN-HITE

MODEL DCA-50 POWER AMPLIFIER

last copy

PRELIMINARY MANUAL

MODEL DCA-50

FINAL OPERATING AND MAINTENANCE MANUAL
WILL BE FORWARDED WHEN PRINTED

KROHN-HITE CORPORATION
580 Massachusetts Avenue, Cambridge 39, Mass., U.S.A.

BULLETIN 110
APRIL, 1961

KROHN-HITE Corporation

50 WATT

WIDE-BAND DIRECT-COUPLED AMPLIFIER

Model DCA-50*

FREQUENCY RANGE: **DC to 500 KC**

FREQUENCY RESPONSE (DC to 500 KC): **±1 DB**

DISTORTION: **0.3%**

DYNAMIC RANGE: **85 DB**

MATCHING LOAD IMPEDANCE: **200 to 330 OHMS**

MAXIMUM OUTPUT VOLTAGE (RMS): **130 VOLTS**

MAXIMUM OUTPUT CURRENT (PEAK): **770 MA**

VOLTAGE GAIN: **20 DB**

The Model DCA-50 Wide-Band, Low-Distortion, Direct-Coupled Power Amplifier will deliver 50 volt-amperes (100 volt-ampere peaks) into a 330 ohm resistive or inductive load over the frequency range from dc to 250 kc (up to 50 kc into a capacitive load), and will deliver 100 watts continuously at dc. Over the frequency range from 1 cps to 500 kc, the amplifier will deliver 50 watts (100 watt peaks) into a 200 ohm resistive load.

The amplifier provides a choice of three voltage gains as determined by the setting of the input selector switch — fixed voltage gains of ten (20 db) with no phase reversal, one (zero db) with a phase reversal, or a continuously variable gain (between zero and ten) by means of the front panel gain control. For each gain setting, the input may be either direct coupled or capacitor coupled with a low cut-off frequency of 1 cps.

Since the Model DCA-50 has a phase reversal in the fixed unity gain position, it can convert a single-ended signal to a balanced signal. Two Model DCA-50 amplifiers can be cascaded to provide a balanced 100-watt output by operating the second amplifier at unity gain.

The amplifier output may be either direct coupled or capacitor coupled for applications requiring zero output dc level. The output dc level of the direct-coupled output may be zeroed by the front panel output dc level screwdriver control. When the capacitor-coupled output is used, the low cut-off frequency is approximately 30 cps with a 330 ohm resistive load.

The Model DCA-50 is basically a three-stage, direct-coupled amplifier. The first two stages are gain stages connected as balanced differential amplifiers for drift cancellation, and operated in push-pull to minimize distortion and provide a balanced output. Four series-parallel-connected power tubes are used in a unique power output stage that provides 50 watts conservatively over an extremely wide frequency range, with low distortion which is characteristic of push-pull operation.

The exceptional performance, frequency response, stability, and low distortion of this highly-linear amplifier is the result of quality components and the use of inverse feedback over an unusually wide frequency range. With this amplifier and a suitable oscillator, high distortion-free power is now available over the entire frequency range from sub-sonic through the audio and ultra-sonic range, and extending into the radio-frequency range. The Model DCA-50 is ideally suited for general purpose laboratory uses, computer systems, vibration analysis, seismological and geophysical studies, and medical and biological research.

*Patent Pending

Model DCA-50 POWER AMPLIFIER

specifications:

The following data applies only to the direct-coupled (DC) positions of the INPUT SELECTOR switch and direct-coupled (DC) OUTPUT terminals, unless otherwise specified.

POWER OUTPUT: 50 volt-amperes (100 volt-ampere peaks), continuous, from dc to 250 kc into a 330 ohm resistive or inductive load; up to 50 kc into capacitive load; 50 watts (100 watt peaks), continuous, from 1 cps to 500 kc into a 200 ohm resistive load. Permissible power output below 1 cps is limited with loads under 330 ohms because the output tube plates may overheat during instantaneous plate dissipation peaks.

OUTPUT VOLTAGE: Greater than 130 volts rms (370 volts peak to peak) open circuit from dc to 500 kc; 128 volts rms (365 volts peak to peak) across 330 ohms from dc to 250 kc; 100 volts rms (283 volts peak to peak) across 200 ohms from 1 cps to 500 kc.

OUTPUT CURRENT: Above 1 cps greater than 550 ma rms (± 770 ma peak) through 10 ohms; 500 ma rms (±700 ma peak) through 200 ohms; 392 ma rms (±550 ma peak) through 330 ohms. Below 1 cps 134 ma rms (±185 ma peak) through 10 ohms; 166 ma rms (±230 ma peak) through 200 ohms; 388 ma rms (±550 peak) through 330 ohms.

OUTPUT REGULATION (from no load to full resistive load): Less than 3% from 10 cps to 100 kc; less than 6% over the entire frequency range.

INTERNAL IMPEDANCE: Less than 6 ohms from 10 cps to 50 kc; 15 ohms from dc to 100 kc; 30 ohms above 100 kc.

LOAD IMPEDANCE: Matching, nominal 200 ohms from 1 cps to 500 kc; below 1 cps, 330 ohms for full power output. Minimum load, 10 ohms.

LOAD POWER FACTOR: Unity to zero, lagging or leading.

OUTPUT DC LEVEL: Zero volts at capacitor-coupled AC OUTPUT terminals; nominal zero volts at the DC OUTPUT terminals.

OUTPUT DC LEVEL STABILITY (typical, after initial warm-up, expressed in per cent of peak output voltage): ±0.02% in any one-hour period at fixed line voltage and ±0.1% for ±10% line voltage change in all positions of the INPUT SELECTOR switch except the X10 DC and POT DC positions where ±0.2% and ±0.5% respectively apply.

VOLTAGE GAIN: Maximum of 10, variable continuously, fixed gain of 10±10% (20±1 db), or fixed gain of 1±10% (0±1 db) as determined by the INPUT SELECTOR switch. Less than ±0.1 db change in gain for a 10% change in line voltage within the operating range.

FREQUENCY RESPONSE: Flat within ±1 db from dc to 500 kc under all specified operating conditions; approximately 3 db down at 800 kc.

PHASE SHIFT (matched load): Zero ±1 degree from dc to 10 kc in the X10 and POT positions of the INPUT SELECTOR switch. In the X1 position, 180 ±1 degrees.

HARMONIC DISTORTION (rms): At full power output, less than 0.3% from 2 cps to 10 kc, less than 0.5% from near dc to 100 kc, and less than 4% above 100 kc. DC linearity within ±2% with loads above 200 ohms.

HUM AND NOISE (referred to output): Less than 5 mv with the input shorted and less than 30 mv with an open circuit input.

DYNAMIC RANGE: Approximately 85 db.

INPUT IMPEDANCE: Greater than 1 megohm in parallel with approximately 50 $\mu\mu$f in the fixed gain positions; 5,000 ohms in parallel with approximately 50 $\mu\mu$f in the variable gain positions.

INPUT COUPLING: Either direct coupling or capacitor coupling with a low cut-off frequency of 1 cps.

INPUT SENSITIVITY: 10 volts rms with a 200 ohm load and 13 volts rms with a 330 ohm load for 50 watts output at maximum gain (X10).

INPUT VOLTAGE LIMITS: 400 volt maximum dc component in the capacitor-coupled (1 CPS) fixed gain positions; combined input signal voltages (ac and dc) must not cause more than 2 watts dissipation in the 5,000 ohm GAIN potentiometer in either variable gain position.

AMBIENT TEMPERATURE AND DUTY CYCLE: Continuous duty at full 50 watt output up to 50°C (122°F) ambient.

FRONT PANEL CONTROLS:
INPUT SELECTOR switch.
GAIN control.
OUTPUT DC LEVEL control (screwdriver adjust).
QUIESCENT CURRENT control (screwdriver adjust).
POWER ON switch.

TERMINALS: Front panel, two multi-purpose binding posts for the INPUT (signal and ground) and three for the OUTPUT (DC signal, AC signal, and ground). Rear of chassis, three BNC coaxial connectors — one for the input, one for the dc output, and one for the ac output.

POWER REQUIREMENTS:
105-125 or 210-250 volts; single phase; 50-60 cycles; 600 watts.

FUSE PROTECTION:
Line: 6¼ Ampere SLOW-blow
Plate Supply: ¾ Ampere SLOW-blow

TUBE COMPLEMENT (furnished with instrument): Four 6DQ5, four 6AS7-GA, two 6CL6, one each: 6AQ5, 12AX7, 5R4-GYA, 6AU5, 6BK7A.

MECHANICAL SPECIFICATIONS: Housed in an attractively styled, louvered steel cabinet, with a cast aluminum front panel and frame. Front panel finished in gray enamel; frame and cabinet in blue enamel. Other finishes available on special order. Model DCA-50 over-all dimensions: 17¼" wide, 9" high, 16" deep. Shipping weight: 112 lbs. (Net weight: 85 lbs.) Also available with standard relay rack panel, designated as Model DCA-50R. Model DCA-50R over-all dimensions: 19" wide, 8¾" high, 16" deep. Weight same as Model DCA-50

Condensed Ordering Specifications:

Model DCA-50 Wide-Band Direct-Coupled Amplifier
Power Output: 50 watts continuous from dc to 500 kc.
Distortion: Less than 0.3% from 2 cps to 10 kc
Voltage Gain: Maximum of 10 (20 db)
Input Impedance: 1 megohm or 5,000 ohms
Output Hum and Noise: Less than 5 millivolts (input shorted)
Load Impedance: Nominal 200 ohms. Below 1 cps, 330 ohms
Input Power: 115/230 volts; 50-60 cycles; 600 watts

PRICE: $685, F.O.B. plant, Cambridge, Mass. Terms: net 30 days.
Specifications and prices are subject to change without notice.

KROHN-HITE CORPORATION
580 Massachusetts Avenue • Cambridge 39, Mass.
UNiversity 4-4272
Pioneering in Quality Electronic Instruments

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SECTION I - GENERAL DESCRIPTION

1. TECHNICAL SUMMARY

The following data applies only to the direct-coupled (DC) positions of the INPUT SELECTOR switch and direct-coupled (DC) output terminals, unless otherwise specified.

POWER OUTPUT: 50 volt-amperes (100 volt-ampere peaks), continuous, from dc to 250 kc into a 330 ohm resistive or inductive load; up to 50 kc into capacitive load; 50 watts (100 watt peaks), continuous, from 1 cps to 500 kc into a 200 ohm resistive load. Permissible power output below 1 cps is limited with loads under 330 ohms because the output tube plates may overheat during instantaneous plate dissipation peaks.

OUTPUT VOLTAGE: Greater than 130 volts rms (370 volts peak to peak) open circuit from dc to 500 kc; 128 volts rms (365 volts peak to peak) across 330 ohms from dc to 250 kc; 100 volts rms (283 volts peak to peak) across 200 ohms from 1 cps to 500 kc.

OUTPUT CURRENT: Above 1 cps greater than 550 ma rms (±770 ma peak) through 10 ohms; 500 ma rms (±700 ma peak) through 200 ohms; 392 ma rms (±550 ma peak) through 330 ohms. Below 1 cps 134 ma rms (±185 ma peak) through 10 ohms; 166 ma rms (±230 ma peak) through 200 ohms; 388 ma rms (±550 peak) through 330 ohms.

OUTPUT REGULATION (from no load to full resistive load): Less than 3% from 10 cps to 100 kc; less than 6% over the entire frequency range.

INTERNAL IMPEDANCE: Less than6 ohms from 10 cps to 50 kc; 15 ohms from dc to 100 kc and less than 30 ohms above 100 kc.

LOAD IMPEDANCE: Matching, nominal 200 ohms from 1 cps to 500 kc; below 1 cps, 330 ohms for full power output. Minimum load, 10 ohms.

LOAD POWER FACTOR: Unity to zero, lagging or leading.

OUTPUT DC LEVEL: Zero volts at capacitor-coupled AC OUTPUT terminals; nominal zero volts at the DC OUTPUT terminals.

OUTPUT DC LEVEL STABILITY (typical, after initial warm-up, expressed in per cent of peak output voltage): ±0.02% in any one-hour period at fixed line voltage and ±0.1% for ±10% line voltage change in all positions of the INPUT SELECTOR switch except the X10 DC and POT DC positions where ±0.2% and ±0.5% respectively apply.

VOLTAGE GAIN: Maximum of 10, variable continuously, fixed gain of 10 ±10% (20±1 db), or fixed gain of 1±10% (0±1 db) as determined by the INPUT SELECTOR switch. Less than ±0.1 db change in gain for a 10% change in line voltage within the operating range.

FREQUENCY RESPONSE: Flat within ±1 db from dc to 500 kc under all specified operating conditions; approximately 3db down at 800 kc.

PHASE SHIFT (matched load): Zero ±1 degree from dc to 10 kc in the X10 and POT positions of the INPUT SELECTOR switch. In the X1 position, 180±1 degrees.

HARMONIC DISTORTION (rms): At full power output, less than 0.3% from 2 cps to 10 kc, less than 0.5% from near dc to 100 kc, and less than 4% above 100 kc. DC linearity within ±2% with loads above 200 ohms.

HUM AND NOISE (referred to output): Less than 5 mv with the input shorted and less than 30 mv with an open circuit input.

DYNAMIC RANGE: Approximately 85 db.

INPUT IMPEDANCE: Greater than 1 megohm in parallel with approximately 50 μμf in the fixed gain positions; 5,000 ohms in parallel with approximately 50 μμf in the variable gain positions.

INPUT COUPLING: Either direct coupling or capacitor coupling with a low cut-off frequency of 1 cps.

INPUT SENSITIVITY: 10 volts rms with a 200 ohm load and 13 volts rms with a 330 ohm load for 50 watts output at maximum gain (X10).

INPUT VOLTAGE LIMITS: 400 volt maximum dc component in the capacitor-coupled (1 CPS) fixed gain positions; combined input signal voltages (ac and dc) must not cause more than 2 watts dissipation in the 5,000 ohm GAIN potentiometer in either variable gain position.

AMBIENT TEMPERATURE and DUTY CYCLE: Continuous duty at full 50 watt output up to 50°C (122°F) ambinent.

FRONT PANEL CONTROLS:

INPUT SELECTOR switch.
GAIN control.
OUTPUT DC LEVEL control (screwdriver adjust).
QUIESCENT CURRENT control (screwdriver adjust).
POWER ON switch.

TERMINALS: Two multi-purpose binding posts for the INPUT (signal and ground) and three for the OUTPUT (DC signal, AC signal, and ground). The Model DCA-50 also has three type BNC coaxial connectors on the rear of the chassis - one for the input, one for the dc output, and one for the ac output.

POWER REQUIREMENTS:

105-125 or 210-250 volts; single phase; 50-60 cycles; 600 watts.

FUSE PROTECTION:

Line: 6 1/4 Ampere SLOW-blow.
Plate Supply: 3/4 Ampere SLOW-blow.

TUBE COMPLEMENT (furnished with instrument): Four 6 DQ5, four 6AS7-GA, two 6CL6, on each: 6AQ5, 12AX7, 5R4-GYA, 6AU5, 6BK7A.

MECHANICAL SPECIFICATIONS:

Housed in an attractively styled, louvered steel cabinet, with a cast aluminum front panel and frame. Front panel finished in gray enamel; frame and cabinet in blue enamel. Other finishes available on special order. Model DCA-50 overall dimensions: 17 1/4" wide, 9" high, 16" deep. Shipping weight: 112 lbs. (Net weight: 85 lbs.) Also available with standard relay rack panel, designated as Model DCA-50R. Model DCA-50R overall dimensions: 19" wide, 8 3/4" high, 16" deep. Weight same as Model DCA-50.

2. DESCRIPTION

The Model DCA-50* is a wide-band, low-distortion, direct-coupled power amplifier. It will deliver 50 volt-amperes (100 volt-ampere peaks) into a 330 ohm resistive or inductive load over the frequency range from dc to 250 kc (up to 50 kc into capacitive load) and will deliver 100 watts continuously at dc. Over the frequency range from 1 cps to 500 kc the Amplifier will deliver 50 watts (100 watt peaks) into a 200 ohm resistive load.

The Amplifier provides a choice of three voltage gains as determined by the setting of the INPUT SELECTOR switch; fixed voltage gains of ten (20 db) with no phase reversal or one (0 db) with a phase reversal, or a continuously variable gain (between zero and ten) with no phase reversal by means of the front panel GAIN control. For each gain setting the input may be either direct coupled or capacitor coupled with a low cut-off frequency of 1 cps.

Since the Model DCA-50 has a phase reversal in the fixed unity gain position, it can convert a single-ended signal to a balanced signal. Two Model DCA-50 Amplifiers can be cascaded to provide a balanced 100 watt output by operating the second Amplifier at unity gain.

The Amplifier output may be either direct coupled (DC) or capacitor coupled (AC) for applications requiring zero output dc level. When the AC output is used, the low cut-off frequency is approximately 25 cps with a 330 ohm resistive load. The output dc level of the direct-coupled (DC) output may be zeroed by the front panel OUTPUT DC LEVEL screwdriver control.

The Model DCA-50 is basically a three-stage, direct coupled amplifier. The first two stages are gain stages connected as balanced differential amplifiers for drift cancellation and operated in push-pull to minimize distortion and provide a balanced output. Four series-parallel connected power tubes are used in the power output stage in a unique circuit which provides 50 watts conservatively over an extremely wide frequency range with low distortion which is characteristic of push-pull operation.

When the Amplifier is operated at the maximum gain of ten (20 db) the input is applied to one grid of the first balanced stage and the voltage feedback is applied to the opposite grid. This provides gain with no phase reversal which is typical of voltage feedback amplifiers. To obtain unity gain with a phase reversal, one grid of the first balanced stage is grounded and the junction of an input-output summing network is applied to the opposite grid as in operational feedback amplifiers.

The exceptional performance, frequency response, stability and low distortion of this highly-linear Amplifier is the result of quality components, good construction, careful engineering and the use of inverse feedback over an unusually wide frequency range. With this Amplifier and a suitable oscillator, high distortion-free power is now available over the entire frequency range from subsonic through the audio and ultrasonic range and extending into the radio-frequency range. The Model DCA-50 is ideally

*Patent Pending

suited for general purpose laboratory uses, computer systems, vibration analysis, seismological and geophysical studies and medical and biological research.

SECTION II - OPERATION

The Model DCA-50 Power Amplifier is adjusted and checked carefully in Final Test to insure that it meets all specifications. It is then aged and again tested prior to shipment to be sure that it is ready for use. The Amplifier is shipped complete and after unpacking is ready to be turned on and used. When rack mounting the Model DCA-50R, it may be necessary to remove the four rubber bumpers mounted on the bottom dust cover. The recommended operating procedure is described below.

1. CONTROLS

a. POWER - The power off-on toggle switch is marked POWER. In the ON position the Amplifier is completely energized and, after less than one minute warm up, may be used. However, a longer time is required to stabilize the output dc level.

b. INPUT SELECTOR - The INPUT SELECTOR switch permits a choice of six different operating conditions in the switch positions marked DC X10, 1 CPS X10, DC X1, 1 CPS X1, DC POT and 1 CPS POT.

In the X10 positions, there is a fixed gain of ten with no phase reversal and the input impedance is approximately one megohm.

In the X1 positions, there is a fixed gain of unity with a phase reversal and the input impedance is also approximately one megohm. These X1 positions provide reduced distortion at frequencies below 500 cps, in addition to a more stable output dc level. The phase reversal enables the Amplifier to convert any single-ended signal into a push-pull balanced signal. Two Model DCA-50 Amplifiers with the OUTPUT of one connected to the INPUT of the other (operating at a X1 position) will provide a combined push-pull output of 100 watts.

In the POT positions there is no phase reversal, the gain is variable up to a maximum of ten as determined by the setting of the GAIN control and the input impedance is approximately 5,000 ohms.

CAUTION

The combined dc plus ac input signals should not dissipate over 2 watts in the 5,000 ohm GAIN control which is connected directly across the INPUT terminals in both POT positions.

In the 1 CPS X10 and 1 CPS X1 positions, the dc component of the input voltage may be as high as 400 volts.

In the three 1 CPS positions, the gain falls off below 1 cps and the output dc level is more stable than in the three DC positions.

c. GAIN - To use the GAIN control, the INPUT SELECTOR switch should be in either of the two positions marked POT. The total gain of the Amplifier is adjustable up to a maximum of ten.

2. LOAD IMPEDANCE

Although the Amplifier may be used with any load of ten ohms or more, the rated 50 watt (or volt-ampere) output is obtained reliably from 1 cps to 250 kc with any resistive load from 200 to 330 ohms. Below 1 cps a 330 ohm resistive load should be used and above 250 kc a 200 ohm resistive load is recommended. When low-resistance loads are used on the DC OUTPUT, the output dc level should be maintained close to zero.

Output power in excess of rating, limited only by the clipping level, may be obtained without damaging the Amplifier, except at frequencies below 1 cps when the load is less than 330 ohms.

For reactive loads, the impedance level is 330 ohms for full 50 volt-ampere output.

Since 50 watts of average sine-wave power corresponds to 100 watt peaks, the Amplifier will provide 100 watts of dc power continuously into a 330 ohm load with a maximum output swing of ±182 volts.

3. LINE VOLTAGE

The Amplifier, as normally shipped, is connected for operation from an ac power source of 105 to 125 volts, 50 to 60 cycles, and uses a 6 1/4 ampere slow-blow line fuse. The Amplifier may be modified for operation from an ac power source of 210 to 250 volts, 50 to 60 cycles, by removing the two jumpers on the four (4) terminal strip, located on the inside of the chassis directly below the line cord, and adding a jumper between the two center terminals. A 3 2/10 slow-blow line fuse should be used for 210-250 volt operation.

A line voltage switch is located on the rear of the chassis. For a line voltage between 105 and 114, this switch should be in the LOW position. For a line voltage between 114 and 125, this switch should be in the HIGH position.

4. TERMINALS

a. INPUT - Two combination-type binding posts are provided on the front panel with the black post grounded. In addition, there is a type BNC input connector on the rear of the chassis.

b. OUTPUT - Three combination-type binding posts are provided on the front panel, one for direct coupling (DC) and one for capacitor coupling (AC) with the middle terminal (GND) grounded. In addition, there are two type BNC output connectors on the rear of the chassis for the direct coupled (DC) and the capacitor coupled (AC) output.

The DC OUTPUT may be used at any frequency. The AC OUTPUT is capacitor coupled to insure zero output dc level and when it is used, the low cut-off frequency varies with the resistance of the load: approximately 40 cps with a 200 ohm load, 25 cps with a 330 ohm load, 1/4 cps with a 100 K load and 1/5 cps with no load.

If long leads are used between the OUTPUT and the load at high frequencies, the capacitive load of the leads must be considered. At 500 kc a shunt capacitance of 200 uuf will reduce the useful power output of the Amplifier approximately 5%.

Reasonable care should be exercised to prevent oscillation caused by stray capacitive coupling of the OUTPUT signal of the Amplifier to the INPUT leads or terminals.

5. TEST JACK VOLTAGE AND OUTPUT DC LEVEL

Adjustments have been made at the Factory for zero output dc level and the correct output-stage quiescent current. The screwdriver controls and corresponding test jacks for the output dc level and quiescent current are on the front panel. With shorted INPUT and the INPUT SELECTOR on DC X10, adjust the OUTPUT DC LEVEL control until the output dc level (as measured across the OUTPUT DC LEVEL test jacks) is zero. This is especially important when using low resistance loads on the DC OUTPUT.

The correct output-stage quiescent current is indicated by a dc reading of minus one volt as measured across the QUIESCENT CURRENT test jacks. Adjust the QUIESCENT CURRENT control until the correct voltage is obtained.

After the Amplifier has had sufficient time to warm up and before extensive use it is recommended that these readings be checked and the controls readjusted if necessary.

6. FUSES AND INDICATORS

The 6 1/4 Ampere SLOW-blow fuse (used with 105-125 volts line) is mounted on the front panel and is in series with the ac input power. When this fuse is open, the associated blown FUSE INDICATOR will light. A 3 2/10 slow-blow line fuse should be used for 210-250 volt operation.

The 3/4 Ampere SLOW-blow fuse, also on the front panel, is in the ground circuit of the regulated power supplies. When this fuse is open, the associated blown FUSE INDICATOR will light, except under some unusual conditions of input signal and output load.

Voltage readings taken with 120V line, line switch in the 114-125 volt position, DC output set for 0 volts, quiescent set for -1 volt, input selector in DC X10 position and input shorted.

Resistance readings taken with HB6's shorted, input selector in the DC X10 position and input shorted.

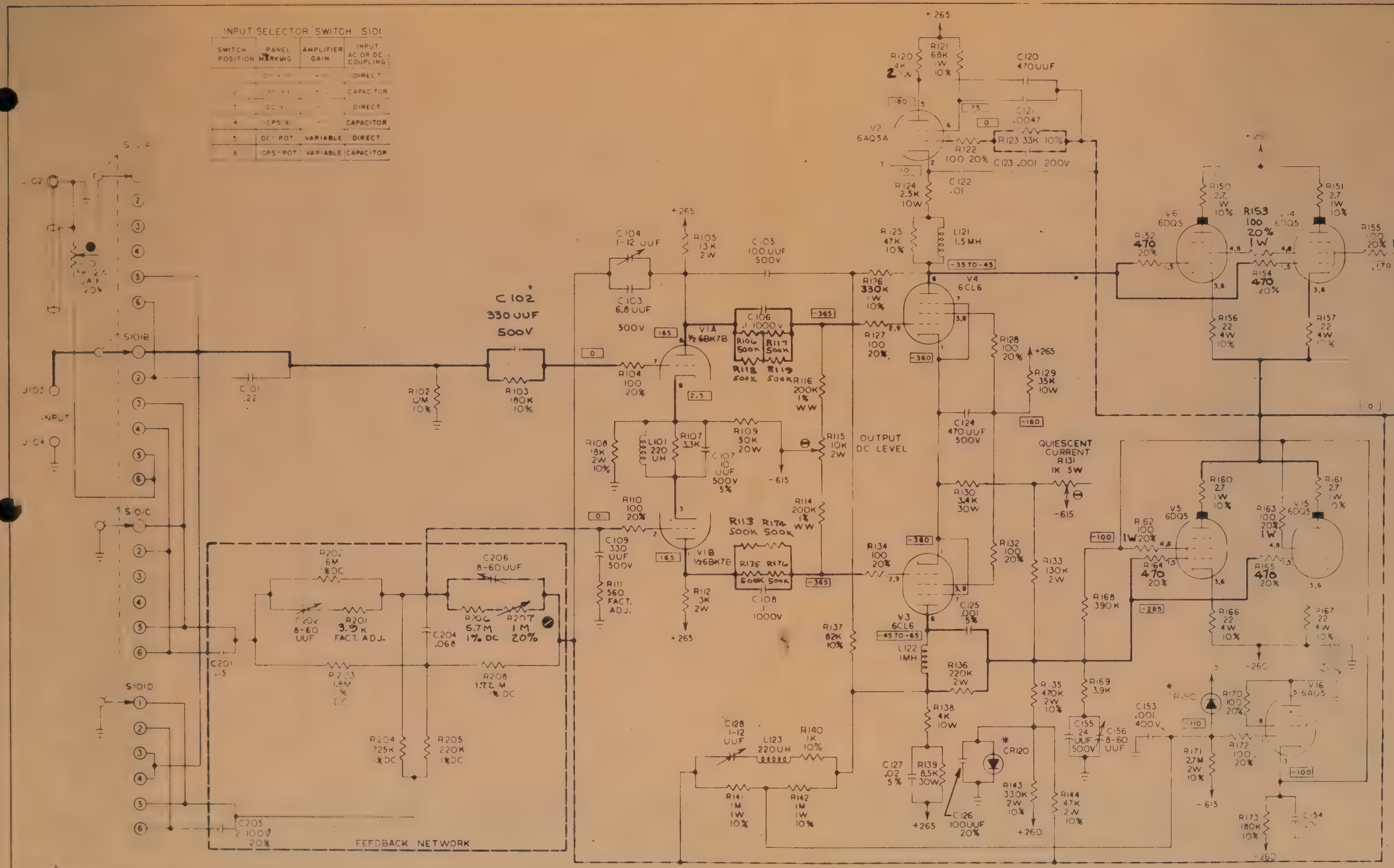
All measurements made with V. T. V. M.

TUBE NO.		PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PLATE CAP
V1	V	165	0±1	2.5	-100	-100	165	0	2.5	0	--
6BK7B	R	25K	600K	15K	150K	150K	25K	180K	15K	0	--
V2	V	0±1	10	0±1	0±1	180	175	0±1			
6AQ5A	R	80K	440K	210K	210K	18K	85K	80K			
V3	V	-360	-365	-160	-350	-350	-45 to -65	-360	-160	-365	
6CL6	R	25K	170K	50K	270K	270K	25K	25K	50K	170K	
V4	V	-360	-365	-160	-350	-350	-35 to -45	-360	-160	-365	
6CL6	R	25K	170K	50K	270K	270K	440K	25K	50K	170K	
V5	V	-285	-350	-260	-100	-285	-260	-350	-100		0±1
6DQ5	R	70K	270K	6K	140K	70K	6K	270K	140K		48K
V6	V	-42	0±1	1.5	170	-42	1.5	0±1	170		260
6DQ5	R	430K	210K	48K	50K	430K	48K	210K	50K		6K
V7	V	--	320	--	-620	--	-620	320	320		
5R4	R	--	14K	--	20K	--	20K	14K	14K		
V8	V	195	370	265	195	370	265	5	5		
6AS7	R	500K	210K	6K	500K	210K	6K	100	100		
V9	V	-55	-250	-260	-100	-100	190	-2	0	-100	
12AX7A	R	480K	140K	6K	150K	150K	500K	160K	0	150K	
V10	V	195	370	265	195	370	265	5	5		
6AS7	R	500K	210K	6K	500K	210K	6K	100	100		
V11	V	-55	120	3	-55	120	5	5	5		
6AS7	R	500K	135K	100	500K	135K	100	100	100		
V12	V	-55	120	3	-55	120	5	5	5		
6AS7	R	500K	135K	100	500K	135K	100	100	100		
V13	V	0	5	5	5	--	0±1	160	--		
6X4	R	48K	100	100	100	--	46K	53K	--		
V14	V	-42	0±1	1.5	170	-42	1.5	0±1	170		260
6DQ5	R	430K	210K	48K	50K	430K	48K	210K	50K		6K
V15	V	-285	-350	-260	-100	-285	-260	-350	-100		0±1
6DQ5	R	70K	270K	6K	140K	70K	6K	270K	140K		48K
V16	V	-110	-100	-100	--	0	-55	-100	0		
6AU5	R	3K	140K	140K	--	0	480K	140K	100		

Model DCA-50 Table of Voltage and Resistance Measurements

INPUT SELECTOR SWITCH S101

SWITCH POSITION	PANEL MARKING	AMPLIFIER GAIN	INPUT AC OR DC COUPLING
1	DC X 10	X 10	DIRECT
2	DC X 1	X 1	CAPACITOR
3	DC X	X	DIRECT
4	CPS X	X	CAPACITOR
5	DC - POT	VARIABLE	DIRECT
6	CPS - POT	VARIABLE	CAPACITOR



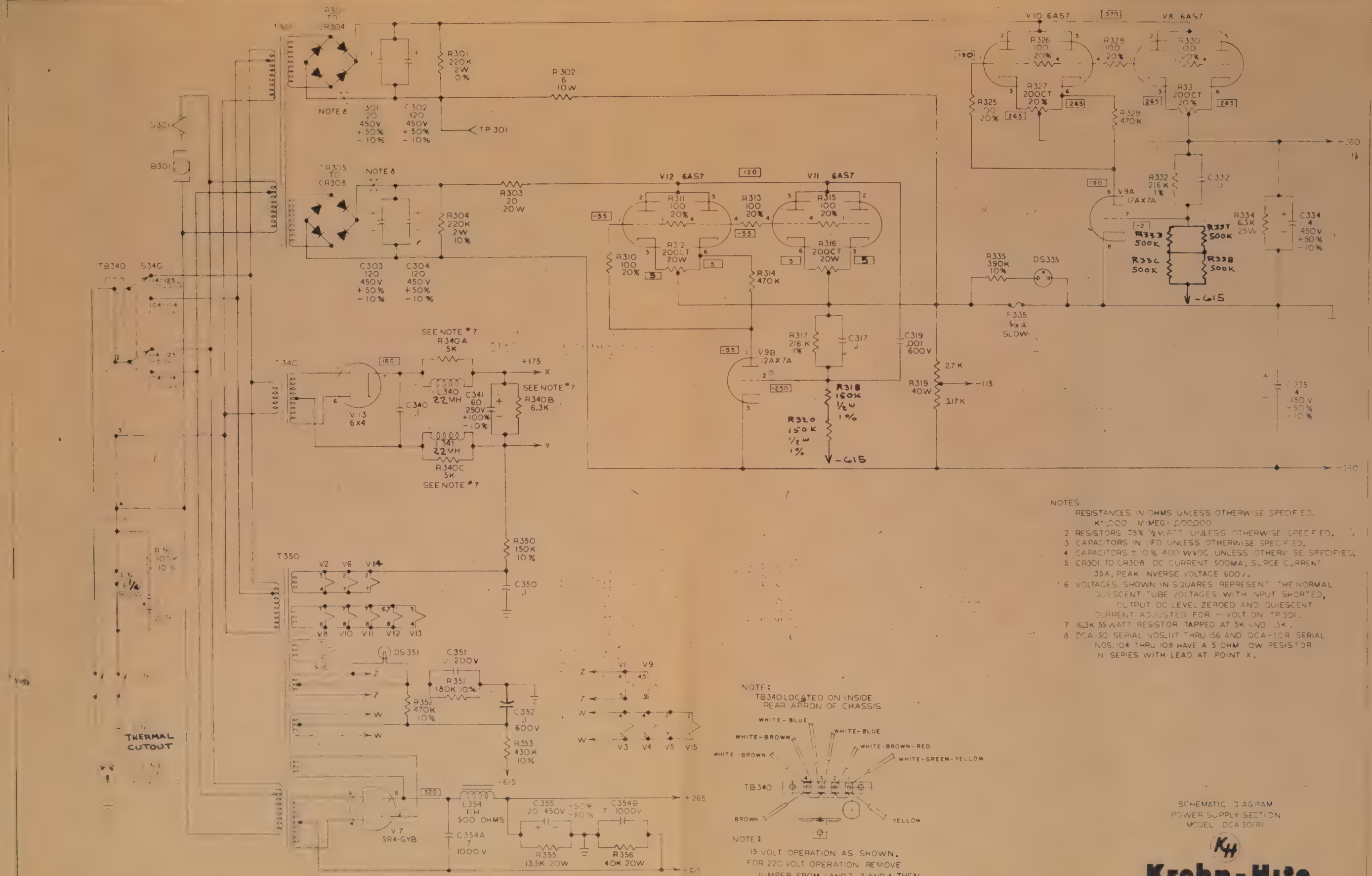
1. RESISTANCE IN OHMS UNLESS OTHERWISE SPECIFIED. K = 1000, M = MEG = 1000,000
2. RESISTORS 5% ½ WATT UNLESS OTHERWISE SPECIFIED.
3. CAPACITANCE IN MFD UNLESS OTHERWISE SPECIFIED.
4. CAPACITORS 10% 400WVDC UNLESS OTHERWISE SPECIFIED
5. TRANSISTOR R150 SPECIFICATION
   PIV > 200V
   RB > 2 MEG
   RF < 200
6. ALL VOLTAGES 20%
7. R150, R151, R160 AND R161 MOLDED IN PLATE LEAD.
8. DC = DEPOSITED CARBON.
9. W W = WIRE WOUND.

VOLTAGES SHOWN IN SQUARES REPRESENT THE NORMAL QUIESCENT TUBE VOLTAGES WITH INPUT SHORTED AND OUTPUT DC LEVEL ZEROED AND QUIESCENT CURRENT ADJUSTED FOR - VOLTS IN TH[illegible]

- KNOB CONTROL
- EXTERNAL SCREWDRIVER ADJUST
- INTERNAL SCREWDRIVER ADJUST
- FEEDBACK SIGNAL PATH
- FORWARD SIGNAL PATH

SCHEMATIC DIAGRAM
WIDE-BAND 50WATT AMPLIFIER
MODEL DCA 50R.

Krohn-Hite
CAMBRIDGE, MASS.



NOTES

1. RESISTANCES IN OHMS UNLESS OTHERWISE SPECIFIED. K=1,000 M=MEG=1,000,000
2. RESISTORS ±5% ½ WATT UNLESS OTHERWISE SPECIFIED.
3. CAPACITORS IN MFD UNLESS OTHERWISE SPECIFIED.
4. CAPACITORS ±10% 400 WVDC UNLESS OTHERWISE SPECIFIED.
5. CR301 TO CR308 DC CURRENT 500MA, SURGE CURRENT 35A, PEAK INVERSE VOLTAGE 600V.
6. VOLTAGES SHOWN IN SQUARES REPRESENT THE NORMAL QUIESCENT TUBE VOLTAGES WITH INPUT SHORTED, OUTPUT DC LEVEL ZEROED AND QUIESCENT CURRENT ADJUSTED FOR -1 VOLT ON TP301.
7. 16.3K 5% WATT RESISTOR TAPPED AT 5K AND 6.3K.
8. DCA-50 SERIAL NOS. 117 THRU 156 AND DCA-50R SERIAL NOS. 104 THRU 108 HAVE A 5 OHM 10W RESISTOR IN SERIES WITH LEAD AT POINT X.

NOTE:
TB340 LOCATED ON INSIDE REAR APRON OF CHASSIS

NOTE:
115 VOLT OPERATION AS SHOWN.
FOR 220 VOLT OPERATION REMOVE JUMPER FROM 1 AND 2, 3 AND 4 THEN CONNECT 2 AND 3 AS SHOWN DOTTED.

SCHEMATIC DIAGRAM
POWER SUPPLY SECTION
MODEL DCA-50(R)

Krohn-Hite
CAMBRIDGE, MASS. U.S.A.

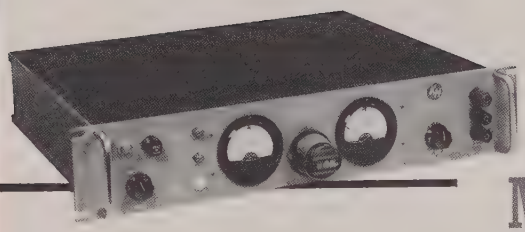
5/64

Krohn-Hite

Quality Electronic Instruments

SHORT FORM CATALOG

TRANSISTORIZED REGULATED POWER SUPPLIES



Model UHR-T361

The one-ampere model of Krohn-Hite's new line of transistorized power supplies — the UHR-T361 — offers the highest regulation and stability of any supply on the market. Line and load regulation are ultra-high; drift, hum and noise, and internal impedance have been reduced through unique design to a negligible level. Other important features include constant voltage or constant current operation, remote control and sensing, variable output current limiting, and short circuit overvoltage and overtemperature protection. The output voltage is automatically restored when a load fault is removed. High efficiency permits simple convection cooling to 60° without fans or blowers. The supply operates at line frequencies from 50 to 400 cps at 115 or 230 volts. Full rated maximum current can be drawn with 100% duty cycle at any output voltage with no de-rating or loss of regulation.

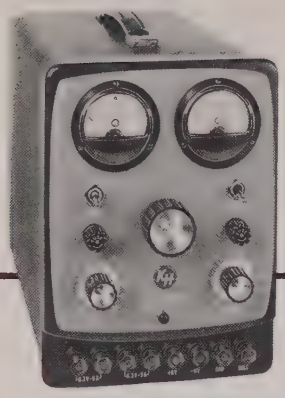
- **0.0005% line and load regulation**
- **50 microvolts hum and noise**
- **250 microhms internal impedance**
- **0.001% short-term drift**
- **Constant current within 0.01%**
- **25 microseconds transient response**
- **Remote sensing and remote voltage control to beyond 100 feet**

OUTPUT		MODEL NO.	REGULATION (%)		OUTPUT IMPEDANCE (OHMS)				HUM & NOISE (μv) (rms)	SHIPPING WEIGHT	PRICE
VOLTS	AMPERES		LINE	LOAD	DC-100 CYCLES	1KC	10KC	100KC			
0-36	0-1	UHR-T361	0.0002 +10μv	0.0005 +25μv	0.00025	0.005	0.05	0.25	50	22 lbs.	$ 850
0-36	0-3	UHR-T363†	0.0002 +10μv	0.0005 +25μv	0.0001	0.004	0.05	0.25	50	40 lbs.	$1000
0-36	0-5	UHR-T365†	0.0002 +10μv	0.001 +50μv	0.0001	0.003	0.05	0.25	50	72 lbs.	$1150
0-36	0-10	UHR-T3610†	0.0002 +10μv	0.001 +50μv	0.00005	0.002	0.05	0.25	50	105 lbs.	$1300

Output voltage controls available: precision ten-turn potentiometer with three-digit dial, or four decade rotary switches (price shown); or single-turn potentiometer ($100 less).

†Rack mounting only.

TUBE REGULATED POWER SUPPLIES



Model UHR-220

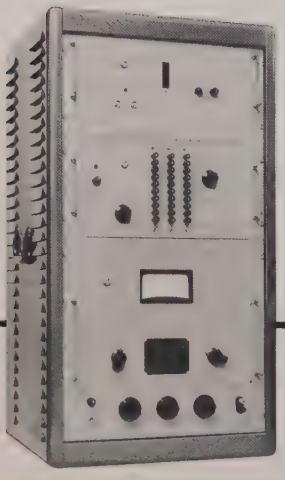
The Model UHR-220 is a compact, portable bench power supply for applications requiring a combination of ultra-high regulation and very low ripple, with additional stabilization versus line voltage for improved stability in the range from 500 down to zero volts. Load regulation and line voltage stabilization remain ultra-high over the entire operating range of zero to 200 ma. No derating is required at maximum voltage and current output, and full-rated maximum current can be drawn with 100% duty cycle at any output voltage. Main dc output features a coarse and fine control, providing vernier coverage of 6 volts anywhere in the operating range.

- **Load regulation less than 0.001% plus 0.002 volt**
- **Line stabilization less than 0.003% plus 0.003 volt**
- **Ripple less than 100 microvolts**
- **DC impedance less than 0.01 ohm**
- **AC impedance less than 0.1 ohm up to 100 kc**
- **Transient response 0.001 millisecond**

VOLTS	MAX. MA	MODEL	DC OHMS	AC OHMS	REGULATION (%)	RIPPLE (μv, rms)	BIAS	HEATERS	SHIPPING WEIGHT	PRICE
0-500	200	UHR-220	0.01	0.1	0.001	100	0-150v,	(2) 6.3v ac, 5a	54 lbs.	$425
140-500	200	UHR-225	0.02	0.1	0.002	100	****	(2) 6.3v ac, 5a	49 lbs.	$325
160-600	100	UHR-216	0.02	0.1	0.001	100	****	(2) 6.3v ac, 5a	49 lbs.	$350
0-500	500	UHR-240	0.005	0.05	0.001	100	0-150v, 5ma	(2) 6.3v ac, 10a 5-13v dc, 2.5a	127 lbs.	$675
140-500	500	UHR-245	0.01	0.05	0.002	100	****	(2) 6.3v ac, 10a	112 lbs.	$495
130-500	1000	UHR-211	0.01	0.03	0.004	200	****	(2) 6.3v ac, 10a	116 lbs.	$850
		UHR-230R Dual Power Supply consists of two Models UHR-220 rack mounted							127 lbs.	$860
		UHR-235R Dual Power Supply consists of two Models UHR-225 rack mounted							117 lbs.	$660
		UHR-236R Dual Power Supply consists of two Models UHR-216 rack mounted							117 lbs.	$710

All cabinet models available rack mounted

AC POWER SOURCES



Model LDS-1500

The Model LDS-1500 Low-Distortion, Stable-Amplitude, Variable Frequency Power Source is designed for use in standards laboratories to supply adequate power for calibration, by the comparison method, of ac voltmeters and ammeters. Fifty watts of power (voltage to 1500 volts and current to 15 amperes) is available over the frequency range from 20 cps to 20 kc with typically 0.1% harmonic distortion. Its exceptionally good short-term amplitude stability, low harmonic distortion and line frequency beat make it ideal for accurate AC measurements, and for calibrating AC electronic and digital voltmeters.

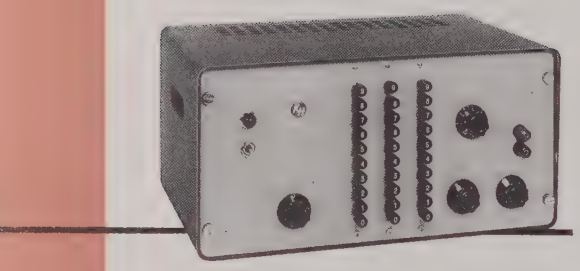
Model LDS-115

For applications requiring an ultra-low-distortion, 50-watt, stable-amplitude, variable frequency power source, with an output of 0 to 115 volts and 0 to 7 amps. Harmonic distortion in this unit is 0.02%. Other specifications are identical to the LDS-1500.

- **50 watts output from 20 cps to 20 kc**
- **0.01% amplitude stability**
- **0.01% amplitude change with line voltage**
- **0.1% amplitude modulation (line frequency beat)**
- **0.02% harmonic distortion**
- **0.02% hum and noise**

OUTPUT VOLTS	OUTPUT AMPS	MODEL	DISTORTION	AMPLITUDE STABILITY SHORT TERM	AMPLITUDE STABILITY ±10% LINE	AMPLITUDE STABILITY HUM BEAT	FREQUENCY RANGE	SHIPPING WEIGHT	PRICE
0-1500	0-15	LDS-1500	0.1%	0.01%	0.01%	0.1%	20-20,000 cps	361 lbs.	$3850
0-115	0-7	LDS-115	0.02%	0.01%	0.01%	0.1%	20-20,000 cps	195 lbs.	$2275

WIDE RANGE RC OSCILLATORS



Model 446

The Model 446 Stable-Amplitude, Ultra-Low Distortion Oscillator is designed for applications requiring extremely high amplitude stability and very low harmonic distortion. The instrument provides exceptionally good short-term stability essential for accurate ac measurements, and nearly complete freedom from "hum bounce" or line frequency beat. The Model 446 is continuously adjustable in frequency from 1 cps to 100 kc. The output voltage level is adjustable from 0 to 10 volts with infinite resolution, using coarse, fine, and vernier amplitude controls.

- **1 cps to 100 kc range**
- **0.01% amplitude stability**
- **0.01% amplitude change with line voltage**
- **0.02% distortion and hum**
- **0.1% hum beat**
- **0.01 db amplitude variation with frequency**

Model 420-A

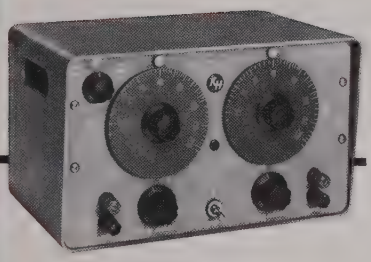
The Model 420-A Low Frequency Oscillator is designed for applications requiring a reliable source of sine wave and square wave voltages in the frequency range of from 0.35 cps to 52 kc. Its circuitry assures low distortion and excellent amplitude stability, and eliminates transients after tuning or band-switching. Hum and distortion are attenuated when the ouput level is reduced, and are maintained at a constant low percentage of the desired output signal.

- **0.35 cps to 52 kc frequency range**
- **1% distortion at any level**
- **Hum less than 0.1% at any output level**
- **±1 db amplitude variation**
- **±2% calibration accuracy**
- **Both sine and square waves simultaneously**

FREQUENCY RANGE	MODEL	FREQUENCY ACCURACY (%)	OUTPUT MW	OUTPUT LOAD (OHMS)	OUTPUT OPEN-CIRCUIT VOLTS	WAVE-FORM	DISTOR-TION (%)	SHIPPING WEIGHT	PRICE
0.001 cps to 100 kc	440-A[2]	1[3]	100	1000	10	∿⊓	0.1[3]	41 lbs.	$ 625
0.001 cps to 100 kc	442[1]	fully programmable Model 440-A						75 lbs.	$1750
0.009 cps to 1.1 kc	400-A	2	25	1000	10	∿⊓	1	21 lbs.	$ 395
0.009 cps to 1.1 kc	400-C[1]	2	100	1000	10	∿⊓	1	26 lbs.	$ 415
0.02 cps to 20 kc	410-A[1]	2	10	600	5	∿⊓	0.1	86 lbs.	$1150
0.35 cps to 52 kc	420-A	2	25	1000	10	∿⊓	1	21 lbs.	$ 330
0.35 cps to 52 kc	420-C[1]	2	100	1000	10	∿⊓	1	26 lbs.	$ 360
1 cps to 1 kc	440-B[2]	0.05[3]	100	1000	10	∿	0.1[3]	41 lbs.	$1150
1 cps to 1 kc	441[1]	fully programmable Model 440-B						75 lbs.	$2525
1 cps to 100 kc	446[2]	1[3]	40	2000	10	∿	0.02[3]	41 lbs.	$1350
1 cps to 100 kc	447[1]	fully programmable Model 446						75 lbs.	$2475
4.6 cps to 520 kc	430-AB	2	50	1000	10	∿	1	18 lbs.	$ 175

(1) Rack panel construction. (2) Pushbutton operation. (3) Poorer at end of range.

VARIABLE ELECTRONIC FILTERS



Model 315-A

The Model 315-A is a band-pass, band-reject, and high-pass variable filter with a frequency range of 20 cps to 200 kc. Any one of the three modes of operation can be selected instantly by a front panel function switch, without changing leads or connections. Gain is unity in the pass bands, and drops outside the pass bands at the rate of 24 db per octave. Both the high-pass and the low-pass cut-off frequencies are independently adjustable from 20 cps to 200 kc for maximum flexibility.

- 20 cps to 200 kc frequency range
- 10% frequency accuracy
- 0±1 db insertion loss
- 24 db attenuation slope (per octave)
- 60 db maximum attenuation
- 6 megohms input impedance
- 500 ohms output impedance
- 0.5 mv (rms) hum and noise
- Direct reading of frequency — no charts

Model 330-M

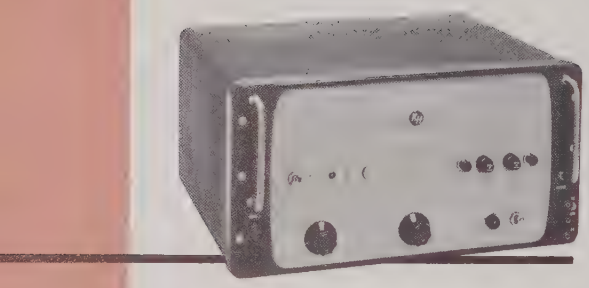
The Model 330-M is a variable electronic band-pass filter that provides unity gain in the pass band and drops outside the pass band at a rate of 24 db per octave. Both the high and low cut-off frequencies are independently adjustable from 0.2 cps to 20 kc for maximum flexibility in setting both the band center frequency and band width. Two identical frequency dials and multiplier switches are used for the two cut-off frequencies. Each dial is single scale, illuminated, direct-reading, and engraved logarithmically from 19 to 210. A multiplier switch selects any one of five decade bands.

- 0.2 cps to 20 kc frequency range
- ±5% cut-off frequency accuracy
- 0±1 db insertion loss
- 24 db per octave attenuation rate
- Maximum attenuation over 80 db
- 22 megohm input impedance
- 500 ohm output impedance
- Less than 100 microvolts rms hum and noise
- Direct reading of frequency — no calibration charts
- Low inherent distortion

FREQUENCY RANGE	TYPE	MODEL	FREQUENCY ACCURACY (%)	NOISE & HUM (mv)	SHIPPING WEIGHT	PRICE
20 cps to 200 kc	Band Pass	310-AB	10(1)	0.5	19 lbs.	$325
20 cps to 200 kc	Rejection	360-AB	10(1)	1	19 lbs.	$350
20 cps to 200 kc	Band-pass, reject, or high-pass	315-A	10	1	19 lbs.	$575
0.2 cps to 20 kc	Band Pass	330-M	5	0.1	34 lbs.	$525
0.02 cps to 2 kc	Band Pass	330-A	5	0.1	42 lbs.	$550
0.02 cps to 2 kc	Rejection	350-A	5	0.1	42 lbs.	$575
0.01 cps to 100 cps	Servo	340-A	5	20	25 lbs.	$475

(1) 5% accuracy available at $50 additional

LABORATORY POWER AMPLIFIERS



Shipping weight: 112 lbs. Price: $685

Model DCA-50

The Model DCA-50 Wide-Band, Low-Distortion, Direct-Coupled Power Amplifier delivers 50 volt-amperes into a 330 ohm load over the frequency range from dc to 250 kc, and 100 watts continuously at dc. Over the frequency range from 1 cps to 500 kc, the amplifier will deliver 50 watts into a 200 ohm resistive load. A choice of three voltage gains is provided by an input selector switch: fixed gains of ten (20 db) with no phase reversal or one (zero db) with a phase reversal, or a continuously variable gain (between zero and ten) by means of the front panel gain control.

- dc to 500 kc frequency range
- ±1 db frequency response (dc to 500 kc)
- 0.3% distortion
- 200 - 330 ohms matching load impedance
- 13 volts input sensitivity
- 85 db dynamic range
- 130 volts maximum output voltage (rms)
- 770 ma maximum output current (peak)
- 20 db maximum voltage gain
- 1 mv noise referred to input

Shipping weight: 40 lbs. Price: $425

Model DCA-10

The Model DCA-10 Wide-Band, Direct-Coupled Amplifier delivers 10 volt-amperes into a 1,000 ohm resistive or inductive load over the frequency range from dc to 500 kc, and delivers 20 watts continuously at dc. Over the range from 1 cps to 1 mc, the DCA-10 delivers 10 watts into a 600 ohm resistive load. Three voltage gains may be selected by a front panel switch: fixed gains of ten (20 db) with no phase reversal or one (zero db) with a phase reversal, or continuously variable gain from zero to ten by means of a front panel gain control. For each gain setting, the input may be either direct-coupled or capacitor-coupled with a low cut-off frequency of 1 cps.

- 10 watts output from dc to 1 mc
- Harmonic distortion less than 0.1%
- ±1 db frequency response from dc to 1 mc
- 20 watt push-pull output from two amplifiers
- 8 volts input sensitivity
- 20 db maximum voltage gain
- 1 megohm or 5,000 ohm input impedance
- Less than 0.1% distortion from 20 cps to 50 kc
- 1 mv noise referred to input

Shipping weight: 111 lbs. Price: $495

Model UF-101A

The Model UF-101A Ultra-Low Distortion Power Amplifier is rated for continuous operation at a 50-watt level with extremely low harmonic, intermodulation, and transient distortion. When used with a suitable oscillator, such as the Krohn-Hite Model 446, the Model UF-101A is ideal as a reference source for low distortion measurements of power components. The Model UF-101A is a highly linear amplifier with unusual gain stability over the frequency range from 20 cps to 20 kc. Phase distortion is negligible, and total noise and hum level is extremely low.

- 50-watt output from 20 cps to 20 kc
- Harmonic distortion less than 0.005% at 1,000 cps
- 80 db feedback
- ±0.5 db frequency response from 0.5 cps to 20 kc
- Intermodulation distortion less than 0.005%
- Load impedances: 1, 2, 4, 8, or 225 ohms
- Input impedances: 7 megohms or 100,000 ohms
- 0.6 volt input sensitivity
- 10 uv noise referred to input

KROHN-HITE CORPORATION

580 Massachusetts Ave. • Cambridge 39, Mass. • 491-3211 (Area Code 617)

Pioneering in Quality Electronic Instruments

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PRICE LIST and CONDENSED SPECIFICATIONS

Effective July 15, 1962

WIDE RANGE RC OSCILLATORS

FREQUENCY RANGE	MODEL	FREQUENCY ACCURACY (%)	DISTORTION (%)	PRICE
0.001 cps to 100 kc	440-A	1	0.1	$ 625
0.001 cps to 100 kc	442 (fully programmable Model 440-A)			$1750
0.009 cps to 1.1 kc	400-A	2	1	$ 445
0.009 cps to 1.1 kc	400-C†	2	1	$ 465
0.35 cps to 52 kc	420-A	2	1	$ 380
0.35 cps to 52 kc	420-C†	2	1	$ 410
1 cps to 20 kc	452*	0.05	0.02	$1975
1 cps to 20 kc	453* (fully programmable Model 452)			$3250
1 cps to 20 kc	450††	0.05	0.1	$1485
1 cps to 20 kc	451 (fully programmable Model 450)			$2625
1 cps to 100 kc	446*	1	0.02	$1350
1 cps to 100 kc	447* (fully programmable Model 446)			$2475
4.6 cps to 520 kc	430-AB	2	1	$ 245

*0.01% short-term amplitude stability †Available in rack model only

††Replaces Model 440-B

VARIABLE ELECTRONIC FILTERS

TYPE	FREQUENCY RANGE	MODEL	FREQUENCY ACCURACY (%)	PRICE
Band-Pass	0.02 cps to 2 kc	330-A	5	$575
Band-Pass	0.2 cps to 20 kc	330-M	5	$525
Band-Pass	20 cps to 200 kc	310-AB	10*	$350
Rejection	0.02 cps to 2 kc	350-A	5	$595
Rejection	20 cps to 200 kc	360-AB	10*	$375
Band-Pass, reject, hi- or low-pass	0.02 cps to 20 kc	335	5	$975
Band-Pass, reject, hi- [redacted]pass	20 cps to 200 kc	315-A	10*	$525
Servo	0.01 cps to 100 cps	340-A	5	$475

*5% accuracy available at $50 additional

TRANSISTORIZED REGULATED POWER SUPPLIES

OUTPUT VOLTS	OUTPUT AMPERES	MODEL NO.	LOAD REGULATION (%)	HUM & NOISE	PRICE
0-36	0-1	UHR-T361	0.0005 +25μv	50μv	$ 850
0-36	0-3	UHR-T363*	0.0005 +25μv	50μv	$1000
0-36	0-5	UHR-T365*	0.001 +50μv	50μv	$1150
0-36	0-10	UHR-T3610*	0.001 +50μv	50μv	$1300

*Available in rack model only.

TUBE REGULATED POWER SUPPLIES

VOLTS	MAX. MA	MODEL	LOAD REGULATION (%)	HUM & NOISE	PRICE
0-500	200	UHR-220	0.001	100μv	$ 495
140-500	200	UHR-225	0.002	100μv	$ 395
0-500	500	UHR-240	0.001	100μv	$ 750
140-500	500	UHR-245	0.002	100μv	$ 575
0-1000	200	UHR-230R	(Dual UHR-220's)	100μv	$1000
140-1000	200	UHR-235R	(Dual UHR-225's)	100μv	$ 800

AC POWER SOURCES

OUTPUT VOLTS	OUTPUT AMPS	MODEL	DISTORTION	STABILITY	FREQUENCY RANGE	PRICE
0-1500	0-15	LDS-1500	0.1%	0.01%	20-20,000 cps	$3850
0-115	0-7	LDS-115	0.02%	0.01%	20-20,000 cps	$2275

LABORATORY POWER AMPLIFIERS

OUTPUT WATTS	MODEL	FREQUENCY RANGE	DISTORTION	MATCHED LOAD (OHMS)	PRICE
10	DCA-10	DC to 1 mc	0.1%	600 to 1000	$ 525
50	DCA-50	DC to 500 kc	0.3%	200 to 330	$ 750
50	UF-101A	20 cps to 20 kc	0.005%	1,2, 4, 8, or 225	$ 595
150	CVC-150	50 cps to 5 kc	0.1%	1.5 to 96	$1075

Rack and bench models same price.

TERMS: Net 30 days FOB Plant, Cambridge, Mass.

Prices and specifications subject to change without notice.

MP MASTER
MA22581